Red River Coal Company Benthic Macroinvertebrate Survey Conducted on March 28, 2012

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EXECUTIVE SUMMARY

Biological Monitoring, Inc. (BMI) performed a stream survey in the South Fork Pound River Watershed for the Red River Coal Company. The purpose of this survey was to conduct instream biological assessments as outlined in the Division of Mine Land Reclamation Guidance Memorandum 32-10 Revised. A total of five (5) stations were sampled.

The Virginia Stream Condition Index (VASCI) protocol was used for instream biological surveys. All biological sampling was performed in accordance with the Virginia Department of Game and Inland Fisheries' scientific collection permit requirements. Instream sampling for chemical analyses were performed concurrently. The instream samples were analyzed for chemical parameters as per permit requirements.

On March 28th, 2012, samples were collected following BMI's Biological Monitoring Program Quality Assurance Project Plan for Wadeable Streams and Rivers. Ephemeroptera, Plecoptera, and Trichoptera were identified to the generic level. All other organisms were identified to the lowest practicable taxonomic level. The US EPA's Rapid Bioassessment Protocols for use in Wadeable Streams and Rivers was used for sampling macroinvertebrate populations and performing habitat assessments.

The analyses of the spring 2012 survey data yielded VASCI scores ranging from 13.76 to 54.87. Using the Virginia Department of Environmental Quality devised scale, these stations were classified in the Severe Stress to Stress Aquatic Life Use (ALU) Tiers. The five monitoring stations habitat assessment scores ranged from 138 (sub-optimal) to 162 (optimal). For comparative purposes, data from three previous sampling events are presented within this report. The limited data accumulated to date lacks the resolution to determine cause and effect relationships.

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1.0 INTRODUCTION

Biological Monitoring, Inc. (BMI) specializes in issues of water quality. Since 1980, BMI has been providing expertise in aquatic toxicology and risk assessment. Highly motivated and academically trained scientists at BMI work closely with clients to create practical solutions to environmental problems. BMI has maintained a commitment to the research and development of aquatic biomonitoring and toxicological concepts resulting in leading edge technologies and applications.

BMI interacts with regulatory agencies on behalf of its clients to solve specific environmental problems associated with water quality and toxicological regulations and permit compliance. With its main facilities located in Blacksburg, Virginia, BMI focuses on the development and application of procedures to create feasible solutions that balance the need for environmental protection and continued economic development.

BMI performed a stream survey for the Red River Coal Company in the South Fork Pound River Watershed located in Wise County. The purpose of this survey was to conduct instream biological assessments as outlined in the Division of Mine Land Reclamation (DMLR) Guidance Memorandum 32-10 Revised (DMLR 2011). The present report provides the methods utilized and the results obtained from the March 28th, 2012 sampling events. For comparative purposes, data from three previous sampling events (November 16th, 2010, April 15th, 2011 and November 1st, 2011) are also reported.

2.0 METHODS AND MATERIALS

2.1 General

On March 28th, 2012, samples were collected following BMI's Biological Monitoring Program Quality Assurance Project Plan for Wadeable Streams and Rivers (QAPP) (BMI 2012). The Virginia Stream Condition Index (VASCI) protocol was used for this instream biological survey (Tetra Tech 2003). The US EPA's Rapid Bioassessment Protocols for use in Wadeable Streams and Rivers (RBP) was used for sampling macroinvertebrate populations and performing habitat assessments (USEPA 1999). Qualitative habitat assessments were conducted at each bioassessment site by trained and experienced individuals. This survey was conducted in accordance with the DMLR Guidance Memorandum No. 32-10 Revised (DMLR 2011). Prior to initiation of this survey, BMI consulted with DMLR personnel to determine the specific monitoring data and locations necessary and appropriate for this project.

2.2 Station Location

Five sampling stations were selected by a representative from DMLR. The stations were located in Wise County, Virginia and within the South Fork Pound River Watershed. Latitude and longitude coordinates were recorded at each station using a Garmin[®] Global Positioning System portable unit (GPSMAP 60 CSX). Table 1 summarizes the monitoring station attributes. Figure 1 provides a map of the area and the locations of each benthic station.

Table 1. Red River Coal Company Monitoring Station Attributes.

Station ID Location Summary		Latitude	Longitude
SFP-1	Most upstream station in South Fork Pound River	37° 03' 57.0"	82° 41' 40.6"
ISEP.2	South Fork Pound River downstream of confluence of Rat Creek	37° 04' 45.9"	82° 39' 30.8"
SC-1	Mouth of Short Creek	37° 04 36.9"	82° 39' 29.4"
RC-1	Mouth of Rat Creek	37° 04' 36.3"	82° 39' 27.1"
GF-1	Mouth of Glady Fork	37° 05' 23.1"	82° 37' 51.4"

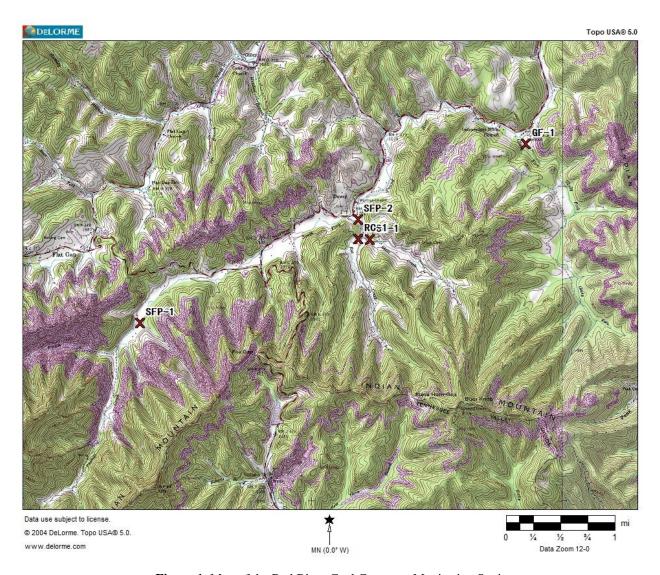


Figure 1. Map of the Red River Coal Company Monitoring Stations

2.3 Macroinvertebrate Sampling & Assessment

2.3.1 Sampling & Identification

All biological sampling was performed in accordance with the Virginia Department of Game and Inland Fisheries' scientific collection permit requirements. Macroinvertebrates were collected at each benthic station following the single habitat approach (riffle-run) as presented in the QAPP (BMI 2012). Samples were collected using a semi-quantitative approach.

Four samples were collected at each station using a 0.50 m wide rectangular kick-net having a 600 µm mesh size. Each sample was collected by first placing the net on the bottom downstream of the 0.50 m² area to be sampled. Where appropriate, large rocks and debris were brushed off into the net and removed. The area to be sampled was then vigorously kicked for approximately 20 seconds. For each of the monitoring stations, the four samples were rinsed, composited, placed in a labeled container, and preserved in 70% ethanol. Sample information was recorded on a BMI Sample Chain of Custody Form and returned to BMI's laboratory for enumeration and identification.

Organisms were separated from the debris in the laboratory. Subsampling was performed on each sample to a standard count of $110 \pm 10\%$. The taxonomic orders Ephemeroptera, Plecoptera, and Trichoptera were identified to the generic level. All other organisms were identified to the lowest practicable taxonomic level. Organism identification utilized the appropriate taxonomic keys (Merritt and Cummins 2008). All organisms from this study will be retained for a period of at least two years.

2.3.2 Macroinvertebrate Data Assessment

Macroinvertebrate data were analyzed using *A Stream Condition Index for Virginia Non-Coastal Streams* (Tetra Tech 2003). This VASCI was developed from an analysis of data collected by the Virginia DEQ from 1994 to 1998 and 1999 to 2002. Using these data, VASCI designated statewide reference values were determined for each of the following six metrics of community structure:

- Total Number of Taxa measures the total number of distinct taxa and, therefore, is representative of the diversity within a sample. High diversity is a strong indicator of stream health and ability to sustain populations. This metric value is expected to decrease in response to increased perturbation.
- Total Number of EPT Taxa is a measure of the total number of distinct taxa within the Orders Ephemeroptera, Plecoptera, and Trichoptera. These orders include the mayflies, stoneflies, and caddis flies, respectively. Organisms in these three orders have low tolerances to perturbation. As a result, the value of the metric is expected to decrease in response to increasing perturbation.
- **Percent EPT** is the percentage of individual Ephemeroptera, Plecoptera, and Trichoptera organisms within a sample. This metric is calculated by dividing the number of EPT organisms by the total number of sample organisms. This metric indicates the relative abundance of these sensitive orders within the stream community. The value of this metric is expected to decrease in response to increasing perturbation.
- **Percent Chironomidae** is the percent individual organisms of the Family Chironomidae within a sample. The metric is calculated by dividing the number of Chironomidae organisms by the total number of sample organisms. Family Chironomidae, the midges, are tolerant to perturbation and their relative abundance tends to increase in impacted streams. As a

result, the value of this metric is expected to increase in response to increasing perturbation.

- Percent Two Dominant Taxa is the percentage of total individuals in the two taxa with the greatest number of organisms. The metric is calculated by adding the number of organisms present in the two largest taxa. Dividing this sum by the total number of organisms yields the relative abundance of the two dominant taxa. Samples with populations concentrated into a few taxa may be an indication of impact. This metric is expected to increase in response to increasing perturbation.
- Hilsenhoff Biotic Index (HBI) was originally designed to evaluate organic pollution by utilizing tolerance values to weight taxa abundance. The resulting HBI value is an estimation of overall pollution level. The metric is expected to increase in response to increasing perturbation.

The VASCI metrics and their expected response to perturbation are summarized in Table 2.

Table 2. VASCI Metrics and Expected Responses.

Metric	Expected Response
Total Number of Taxa	Decrease
Total Number of EPT Taxa	Decrease
Percent EPT	Decrease
Percent Chironomidae	Increase
Percent 2 Dominant Taxa	Increase
Hilsenhoff Biotic Index	Increase

VASCI scores for each of the five monitoring stations were calculated by dividing each station's metric values by the corresponding VASCI statewide reference values. This yielded a percentage score for each metric relative to the statewide reference condition. If the percentage score of any individual metric was greater than 100, the score was

truncated to 100. The six resulting values were then averaged to arrive at the VASCI score for each station.

2.4 Habitat Assessment

Habitat assessments were performed at each benthic station where macroinvertebrates were collected. These assessments were performed as per the RBP (USEPA 1999). Ten habitat parameters were assessed, each receiving a score of 0 - 20. A description of each of the habitat parameters follows:

- Epifaunal Substrate / Available Cover rate the availability of structures in the stream that can be utilized as refuge, spawning, and feeding sites by macroinvertebrates. Examples of such structures would include boulders, cobble, undercut banks, roots, logs and branches. The availability of cover can be a limiting factor on stream diversity and abundance.
- Embeddedness rate the degree to which coarse substrate such as gravel; cobble and boulders are sunken into the sand, silt and mud substrate of the stream bottom. Embeddedness is the result of sediment movement and deposition. Increased embeddedness reduces the available refuge, feeding and spawning sites available to macroinvertebrates resulting in lower diversity and abundance.
- Velocity / Depth Regimes gauge the presence or absence of four velocitydepth patterns. These patterns are slow-deep, slow-shallow, fast-deep, and fast-shallow. Ideally, all four patterns should be present to best provide a stable diverse stream community.
- **Sediment Deposition** rates the degree to which new sediment has accumulated in pools, point bars and islands. Sediment deposition may be an indicator of an unstable environment and lowered diversity.

- Channel Flow Status rates the degree to which water fills the stream channel. Channel flow status may be affected by obstructions, diversions or widening of the stream channel. As less of the channel is filled by water, the amount of suitable substrate is also reduced.
- Channel Alteration rate the degree to which the shape of the stream channel has been altered. Alterations may include bridges, roads, diversion channels, channel straightening, artificial embankments, riprap, dams, weirs, and other instream structures. Channel alteration often results in scouring and loss of available habitat.
- Frequency of Riffles (or Bends) rates the presence of quality riffle or sinuous habitat. Riffles and sinuous streams provide quality habitat for stable, diverse communities.
- Bank Stability indicates the degree to which banks have eroded or may erode. Eroded banks are a sign of sediment movement and deposition, which leads to reduced epifaunal habitat. Unstable banks may also point to poor vegetative cover.
- Bank Vegetative Protection gauges the extent of vegetative protection at the stream bank and the nearby riparian zone. Bank vegetation plays a vital role in erosion control, nutrient uptake, stream shading, and food supply.
- Riparian Vegetative Zone Width measures the extent of natural vegetation from the stream through the riparian zone. Wide vegetative zones provide pollution buffering, erosion control, habitat, nutrient uptake and nutrient input. These beneficial contributions can be impaired by commercial and residential development, roads, pastures, actively worked fields, etc.

Table 3 identifies each of the ten Habitat Assessment Parameters and their range of scores. Scores for each parameter were recorded on Habitat Assessment Field Log Sheets (USEPA 1999). The habitat assessment score for each station was calculated by adding the score for each parameter yielding a station total. The highest attainable score was 200. The actual habitat assessment process involves rating the ten parameters as optimal (>153), suboptimal (101-153), marginal (46-100), or poor (<45).

Table 3. Habitat Assessment Parameters

Parameter	Description	Scoring
1	Epifaunal Substrate / Available Cover	0-20
2	Embeddedness	0-20
3	Velocity / Depth Regime	0-20
4	Sediment Deposition	0-20
5	Channel Flow Status	0-20
6	Channel Alteration	0-20
7	Frequency of Riffles or Bends	0-20
8	Donk Stability	Left 0-10
8	Bank Stability	Right 0-10
9	Vagatativa Protection	Left 0-10
9	Vegetative Protection	Right 0-10
10	Dinarian Vagatativa Zana Width	Left 0-10
10	Riparian Vegetative Zone Width	Right 0-10

2.5 Water Quality Assessment

Prior to any field data collections, all handheld meters were calibrated. Conductivity (μS), pH, temperature (°C) and flow were recorded at each of the five sample stations. Conductivity, pH and Temperature were all recorded using a Hanna Instruments Portable pH/EC/TDS/Temperature Meter (HI 991300). Stream velocities were measured using a Global Water Flow Probe FP101. Stream discharge was calculated using the Mid-Section Velocity Area Method (Buchanan 1969). Instream sampling for additional analyses were performed concurrent to the biological sampling. These samples were taken to Environmental Monitoring, Inc. of Norton, VA for subsequent analysis. The analysis conducted for each station included the parameters listed in Table 4.

Table 4. Chemical parameters for used for analysis

Flow (gpm)	Manganese (mg/L)	Total Arsenic (µg/L)
Temperature (°C)	Magnesium (mg/L)	Total Beryllium (µg/L)
pH (STD units)	Total Acidity (mg/L)	Total Cadmium (µg/L)
TSS (mg/L)	Total Alkalinity (mg/L)	Total Chromium (µg/L)
Specific Conductance (µS/cm)	Bicarbonate Alkalinity (mg/L)	Total Copper (µg/L)
TDS (mg/L)	Carbonate Alkalinity (mg/L)	Total Lead (µg/L)
Sulfates (mg/L)	Hardness (mg/L)	Total Mercury (µg/L)
Chlorides (mg/L)	Total Zinc (µg/L)	Total Nickel (µg/L)
Aluminum (mg/L)	Total Antimony (µg/L)	Total Selenium (µg/L)
Iron (mg/L)	Total Silver (µg/L)	Total Thallium (µg/L)
Total Cobalt (µg/L)	Nitrate (mg/L)	Total Barium (µg/L)
Total Cyanide (µg/L)	Nitrite (mg/L)	Total Boron (µg/L)
Total Phenols (µg/L)	Diss. Organic Carbon (mg/L)	

3.0 RESULTS

3.1 Station Location

Since they were selected by DMLR personnel, the five monitoring stations were assumed to be representative of the appropriate outfalls in this watershed. Station attributes, including latitudes and longitudes, are presented in Table 1 and depicted in Figure 1. Station photographs and descriptions are presented in Appendix A. Flows were adequate for sampling at all stations.

3.2 Macroinvertebrate Monitoring Data

3.2.1 Virginia Stream Condition Index Metrics

The VASCI metric values for the Red River Coal Company monitoring stations sampled in March 2012 are summarized in Table 5. The Number of Taxa ranged from 5 (SFP-1, SFP-2, and RC-1) to 12 (GF-1) and the Number of EPT Taxa ranged from 1 (SFP-1) to 8 (GF-1). The Percent EPT (less Hydropsychidae) ranged from 0 (SFP-1) to 70.09 (GF-1) and Percent Chironomidae ranged from 19.66 (GF-1) to 89.09 (SFP-1). The remaining two metrics, Percent Two Dominant Taxa and Hilsenhoff Biotic Index (HBI) had ranges of 81.20 (GF-1) to 94.55 (SFP-1) and 3.03 (GF-1) to 5.95 (SFP-1), respectively. Identification and enumeration data for the March 2012 sampled stations are presented in Appendix B.

Tables 6, 7 and 8 present the metric values from Fall and Spring 2011 and Fall 2010 sampling season.

Table 5. Red River Coal Company Station VASCI Metrics for Spring 2012.

Station ID	Number of Taxa	Number of EPT Taxa	Percent EPT (less Hyd.)	Percent Chiron.	Percent Two Dom. Taxa	HBI Score
SFP-1	5	1	0	89.09	94.55	5.95
SFP-2	5	3	7.92	86.14	90.10	5.68
SC-1	10	6	15.60	72.48	81.65	5.22
RC-1	5	3	1.98	88.12	94.06	5.89
GF-1	12	8	70.09	19.66	81.20	3.03

Table 6. Red River Coal Company Station VASCI Metrics for Fall 2011.

Station ID	Number of Taxa	Number of EPT Taxa	Percent EPT (less Hyd.)	Percent Chiron.	Percent Two Dom. Taxa	HBI Score
SFP-1	5	1	0	67.24	82.76	5.98
SFP-2	7	4	21.85	60.50	79.83	4.92
SC-1	10	6	35.29	40.20	67.65	3.90
RC-1	8	3	14.85	67.33	79.21	5.27
GF-1	9	5	56.30	13.45	63.03	3.15

Table 7. Red River Coal Company Station VASCI Metrics for Spring 2011.

Station ID	Number of Taxa	Number of EPT Taxa	Percent EPT (less Hyd.)	Percent Chiron.	Percent Two Dom. Taxa	HBI Score
SFP-1	4	0	0	46.53	97.03	5.96
SFP-2	6	2	4.81	90.38	95.19	5.74
SC-1	3	1	9	90	99	5.44
RC-1	3	1	0	97.30	99.10	5.97
GF-1	7	4	67.33	5.94	83.17	1.82

Table 8. Red River Coal Company Station VASCI Metrics for Fall 2010.

Station ID	Number of Taxa	Number of EPT Taxa	Percent EPT (less Hyd.)	Percent Chiron.	Percent Two Dom. Taxa	HBI Score
SFP-1	6	1	0	55.56	87.65	6.06
SFP-2	10	5	29.79	23.40	56.38	4.57
SC-1	10	5	34.75	50.85	66.95	4.28
RC-1	14	6	9.30	46.51	67.44	5.47
GF-1	15	8	68.63	5.88	44.12	2.82

3.2.2 Virginia Stream Condition Index Scores

VASCI scores were calculated for all monitoring stations. Table 9 presents a summary of the VASCI scores from the Red River Coal Company monitoring stations for March 2012. VASCI scores calculated for the Red River Coal Company monitoring stations ranged from 13.76 (SFP-1) to 54.87 (GF-1).

Tables 10, 11 and 12 present VASCI scores from Fall and Spring 2011 and Fall 2010 sampling season.

Station	Number of	Number of	Percent	Percent	Percent Two	HBI	VASCI
ID	Taxa	EPT Taxa	EPT	Chiron.	Dom Taxa	Score	Score
SFP-1	22.73	9.09	0	10.91	7.88	59.49	13.76
SFP-2	22.73	27.27	22.25	13.86	14.31	63.48	20.49
SC-1	45.45	54.55	43.81	27.52	26.52	70.29	33.52
RC-1	22.73	27.27	5.56	11.88	8.58	60.43	17.06
GF-1	54 55	72 73	196.87	80 34	27 17	102 44	54 87

Table 9. Red River Coal Company Monitoring Station VASCI Scoring Spring 2012.

Station ID	Number of Taxa	Number of EPT Taxa	Percent EPT	Percent Chiron.	Percent Two Dom Taxa	HBI Score	VASCI Score
SFP-1	22.73	9.09	0	32.76	24.92	59.08	18.57
SFP-2	31.82	36.36	61.37	39.50	29.14	74.64	34.10
SC-1	45.45	54.55	99.14	59.80	46.75	89.68	50.02
RC-1	36.36	27.27	41.72	32.67	30.05	69.60	29.71
GF-1	40.91	45.45	158.15	86.55	53.43	100.72	53.29

Table 11. Red River Coal Company Monitoring Station VASCI Scoring Spring 2011.

Station ID	Number of Taxa	Number of EPT Taxa	Percent EPT	Percent Chiron.	Percent Two Dom Taxa	HBI Score	VASCI Score
SFP-1	18.18	0	0	53.47	4.29	59.41	16.92
SFP-2	27.27	18.18	13.50	9.62	6.95	62.64	17.27
SC-1	13.64	9.09	25.28	10	1.45	67.06	15.81
RC-1	13.64	9.09	0	2.70	1.30	59.22	10.74
GF-1	31.82	36.36	189.12	94.06	24.32	120.27	48.32

Table 12. Red River Coal Company Monitoring Station VASCI Scoring Fall 2010.

Station ID	Number of Taxa	Number of EPT Taxa	Percent EPT	Percent Chiron.	Percent Two Dom Taxa	HBI Score	VASCI Score
SFP-1	27.27	9.09	0	44.44	17.84	57.92	19.57
SFP-2	45.45	45.45	83.67	76.60	63.03	79.79	49.25
SC-1	45.45	45.45	97.60	49.15	47.76	84.12	46.19
RC-1	63.64	54.55	26.13	53.49	47.05	66.69	40.13
GF-1	68.18	72.73	192.77	94.12	80.75	105.54	64.47

3.3 **Habitat Assessment**

Table 13 presents a summary of the habitat assessment scores for the Red River Coal Company monitoring stations from the March sampling event. Habitat assessment scores ranged from 138 (SC-1) (sub-optimal) to 162 (RC-1) (optimal).

Tables 14, 15 and 16 include a summary of habitat assessment scores from Fall and Spring 2011 and Fall 2010 sampling seasons.

Table 13. Red River Coal Company Monitoring Station RBP Habitat Scoring Spring 2012.

Parameter	SFP-1	SFP-2	SC-1	RC-1	GF-1
Subst./Cover	17	17	18	19	18
Embeddedness	16	16	14	16	14
Velocity	15	10	11	17	15
Sediment Dep.	13	17	16	16	12
Channel Flow	19	19	18	19	19
Channel Alt.	17	15	12	15	15
Freq of Riffles	16	20	19	18	19
Bank Stab L	8	10	7	9	8
Bank Stab R	8	9	5	7	8
Veg. Prot. L	6	10	5	9	9
Veg. Prot. R	9	4	8	6	9
Rip. Zone L	5	4	1	10	10
Rip. Zone R	10	0	4	1	2
Total	159	151	138	162	158

Table 14. Red River Coal Company Monitoring Station RBP Habitat Scoring Fall 2011.

Parameter	SFP-1	SFP-2	SC-1	RC-1	GF-1
Subst./Cover	14	17	18	19	16
Embeddedness	15	10	16	18	9
Velocity	4	19	15	15	15
Sediment Dep.	18	13	15	16	10
Channel Flow	16	17	13	15	17
Channel Alt.	19	12	18	10	18
Freq of Riffles	16	18	16	17	20
Bank Stab L	9	8	8	9	7
Bank Stab R	8	9	8	8	4
Veg. Prot. L	9	9	9	7	9
Veg. Prot. R	10	6	4	9	4
Rip. Zone L	8	4	10	2	10
Rip. Zone R	10	4	2	2	2
Total	156	146	152	147	141

Table 15. Red River Coal Company Monitoring Station RBP Habitat Scoring Spring 2011.

Parameter	SFP-1	SFP-2	SC-1	RC-1	GF-1
Subst./Cover	16	16	16	17	18
Embeddedness	18	17	12	13	16
Velocity	7	10	5	8	16
Sediment Dep.	19	19	19	19	18
Channel Flow	14	19	19	19	19
Channel Alt.	14	15	14	14	15
Freq of Riffles	17	19	19	19	11
Bank Stab L	6	8	9	9	9
Bank Stab R	9	9	9	9	9
Veg. Prot. L	5	9	6	10	10
Veg. Prot. R	10	9	6	7	9
Rip. Zone L	6	6	1	10	8
Rip. Zone R	10	3	1	0	7
Total	151	159	136	154	165

Table 16. Red River Coal Company Monitoring Station RBP Habitat Scoring Fall 2010.

Parameter	SFP-1	SFP-2	SC-1	RC-1	GF-1
Subst./Cover	17	14	10	8	11
Embeddedness	7	12	16	11	15
Velocity	11	19	8	4	11
Sediment Dep.	10	16	16	10	18
Channel Flow	13	16	9	9	14
Channel Alt.	11	12	10	11	15
Freq of Riffles	11	11	15	16	18
Bank Stab L	2	7	7	6	8
Bank Stab R	4	6	6	6	8
Veg. Prot. L	6	4	7	3	5
Veg. Prot. R	3	1	4	6	4
Rip. Zone L	2	3	4	1	7
Rip. Zone R	4	0	0	4	2
Total	101	121	112	95	136

3.4 Water Quality Assessment

Instream conductivity, pH, temperature and flow were recorded at each station. Table 17 presents the instream water quality assessments from the March 2012 sampling event. The conductivity ranged from 263 (SC-1) to 2070 (SFP-1) and the pH ranged from 7.05 (GF-1) to 8.10 (SFP-2). The water temperature ranged from 12.7 (GF-1) to 16.2 (RC-1) and flow ranged from 7.5 (GF-1) to 28.18 (SFP-2).

Tables 18, 19 and 20 include a summary of water quality analyses from Fall and Spring 2011 and Fall 2010 sampling seasons.

Table 17. Red River Coal Company Water Quality Analyses Spring 2012

Station ID	Conductivity(µS/cm)	pН	Water Temp (°C)	Flow (cfs)
SFP-1	2070	7.30	15.4	19.07
SFP-2	1887	8.10	15.4	28.18
SC-1	263	7.18	14.3	1.25
RC-1	1278	7.40	16.2	3.55
GF-1	523	7.05	12.7	7.5

Table 18. Red River Coal Company Water Quality Analyses Fall 2011

Station ID	Station ID Conductivity(µS/cm)		Water Temp (°C)
SFP-1	2019	7.27	14.0
SFP-2	1899	8.23	12.6
SC-1	1192	7.7	10.0
RC-1	334	7.4	9.6
GF-1	494	7.35	8.1

Table 19. Red River Coal Company Water Quality Analyses Spring 2011

Station ID	Conductivity(µS/cm)	Water Temp (°C)
SFP-1	1857	12.9
SFP-2	1573	12.6
SC-1	267	11.9
RC-1	1175	11.9
GF-1	971	12.7

Table 20. Red River Coal Company Water Quality Analyses Fall 2010

Station ID	pН	Conductivity(µS/cm)	Water Temp (°C)	Dissolved Oxygen. (mg/L)
SFP-1	6.80	1899	14.3	5.40
SFP-2	8.37	2238	12.6	8.30
SC-1	6.87	1303	11.2	8.50
RC-1	6.72	338	11.1	7.00
GF-1	7.86	971	10	9.40

4.0 DISCUSSION

Water quality and both instream and riparian habitat are important determinants of the composition, structure, and function of biotic communities. The instream water quality assessments and the RBP Habitat Assessment techniques used in this study do not provide adequate discriminatory power to differentiate cause and effect. A systematic assessment of instream and riparian habitat quality is necessary to fully assess water quality conditions in streams and rivers (USEPA 1999).

4.1 Station Location

Since DMLR selected these sample locations, it is assumed that they are representative of the permit(s) in question. Furthermore, this study represents a significant component of the holistic watershed management approach cited in DMLR Guidance Memorandum 32-10 Revised (DMLR 2011).

4.2 Macroinvertebrate Data

The VASCI values in this study should be considered a relative ranking, indicating the comparability of the studied stream to the statewide reference for least disturbed streams. As such, these values should not be considered an absolute rating.

The VASCI validation document recommends Aquatic Life Use tiers based on the VASCI scores (VADEQ 2006). These tiers and their respective scores are as follows:

- > "Severe Stress indicates scores below 43;
- > "Stress" indicates scores from 43 to 59;
- > "Good" conditions indicate scores from 60 to 72; and
- ➤ "Excellent" stream quality is represented by scores above 72.

Table 21 presents a comparison of Fall 2010, Spring 2011, Fall 2011 and Spring 2012 VASCI scores. The VASCI scores from the Red River Coal Company sampling event of March 2012 fell within ALU tiers ranging from Severe Stress (13.76) for SFP-1 to Stress (54.87) for GF-1. The range of VASCI scores over all four sampling events were 10.74 at RC-1 (Spring 2011) to 64.47 at GF-1 (Fall 2010).

Table 21. Comparison of recent VASCI scores

Station ID	Fall 2010	Spring 2011	Fall 2011	Spring 2012
SFP-1	19.57	16.92	18.57	13.76
SFP-2	49.25	17.27	34.1	20.49
SC-1	46.19	15.81	50.02	33.52
RC-1	40.13	10.74	29.71	17.06
GF-1	64.47	48.32	53.29	54.87

At Station SFP-1, all four sampling events resulted in VASCI scores within the same ALU Tier (Severe Stress). At SFP-2, the Fall 2010 score represented the Stress tier while the other three season scores represented Severe Stress. Station SC-1 scored as Severe Stress in both the Spring seasons and Stress in the Fall seasons. At RC-1, all sampling events yielded the Severe Stress ALU. At Station GF-1, the Fall 2010 score fell within the Good ALU tier. The other three season scores were classified under the Stress ALU tier. Table 22 presents a comparison of the ALU tiers found in four seasons of sampling.

Table 22. Comparison of recent ALU tiers

Station ID	Fall 2010	Spring 2011	Fall 2011	Spring 2012	
SFP-1	Severe Stress	Severe Stress	Severe Stress	Severe Stress	
SFP-2	Stress	Severe Stress	Severe Stress	Severe Stress	
SC-1	Stress	Severe Stress	Stress	Severe Stress	
RC-1	Severe Stress	Severe Stress	Severe Stress	Severe Stress	
GF-1	Good	Stress	Stress	Stress	

4.3 Habitat Assessment

Habitat plays an important role in species composition, various assemblages and numbers of organisms found in aquatic environments. To make meaningful impact analyses, one must consider habitat data as a possible limiting factor. However, RBP habitat assessment techniques are qualitative in nature and designed to determine comparability and ranking amongst stations. Traditionally, this approach assumes the presence of a reference station for the data set. To further explore the role habitat may be playing on the benthic scores, additional data will have to be collected.

Table 23 presents a comparison of Fall 2010, Spring 2011, Fall 2011 and Spring 2012 Habitat Assessment scores. The habitat scores from the Red River Coal Company sampling event of March 2012 ranged from Sub-optimal (138) for SC-1 to Optimal (162) for RC-1. The range of Habitat Assessment scores over all four sampling events was 95 at RC-1 (Fall 2010) to 165 at GF-1 (Spring 2011).

Spring 2012 **Station ID Fall 2010** Spring 2011 **Fall 2011** 151 156 159 SFP-1 101 159 146 151 SFP-2 121 136 138 SC-1 112 152 154 162 RC-1 95 147 GF-1 136 165 141 158

Table 23. Comparison of recent Habitat Scores

At Station SFP-1, Fall 2010 and Spring 2011 sampling events resulted in Sub-optimal Habitat Assessment scores. The Fall 2011 and Spring 2012 sampling events for SFP-1 had Optimal Habitat Assessment scores. At SFP-2, the Spring 2011 score represented an Optimal Habitat Assessment score while the other three season scores represented Sub-optimal habitat. Station SC-1 scored as Sub-optimal in all four seasons. At RC-1, Fall 2010 had a Marginal habitat score while Fall 2011 was scored Sub-optimal. The other two seasons were said to have Optimal habitat. At Station GF-1, both Fall seasons scored within the Sub-optimal habitat category. The other two season scores were classified as

Optimal habitat. Table 24 presents a comparison of the Habitat Assessment scores found in four seasons of sampling.

Table 24. Comparison of recent Habitat Score Classifications

Station ID	Fall 2010	Spring 2011	Fall 2011	Spring 2012
SFP-1	Sub-optimal	Sub-optimal	Optimal	Optimal
SFP-2	Sub-optimal Optimal Su		Sub-optimal	Sub-optimal
SC-1	Sub-optimal	Sub-optimal	Sub-optimal	Sub-optimal
RC-1	Marginal	Optimal	Sub-optimal	Optimal
GF-1	Sub-optimal	Optimal	Sub-optimal	Optimal

4.4 Water Quality Assessment

The instream water chemistry parameters examined, conductivity, pH, temperature and flow, were typical for streams influenced by urban environments and mining in the region.

5.0 LITERATURE CITED

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APPENDIX A: STATION PHOTOGRAPHS AND DESCRIPTIONS

SFP-1



Figure 2. Photos of SFP-1

This station is the most upstream station on the South Fork Pound River. Upstream (top left), downstream (top right), left bank (bottom left) and right bank (bottom right) view of station SFP-1.

SFP-2



Figure 3. Photos of SFP-2

Station SFP-2 is located on the South Fork Pound River downstream from the confluence of Rat Creek and South Fork Pound River. Upstream (top left), downstream (top right), left bank (bottom left) and right bank (bottom right) view of station SFP-2.

SC-1



Figure 4. Photos of SC-1

Station SC-1 is located at the mouth of Short Creek. Upstream (top left), downstream (top right), left bank (bottom left) and right bank (bottom right) view of station SC-1.

RC-1



Figure 5. Photos of RC-1

Station RC-1 is located upstream from the confluence of Rat Creek and Short Creek. Upstream (top left), downstream (top right), left bank (bottom left) and right bank (bottom right) view of station RC-1.

GF-1



Figure 6. Photos of GF-1

Station GF-1 is located near the mouth of Glady Fork. Upstream (top left), downstream (top right), left bank (bottom left) and right bank (bottom right) view of station GF-1.

APPENDIX B: MONITORING DATA

PH: 540-953-2821 FAX: 540-951-1481 WWW.BIOMON.COM

Biological Sample Chain of Custody Form

	·					
Project Information						
Client: ROS Diver						
Project Name:						
Project Number:	Station ID:					
County/City:	State: \/A					
Stream Name:	Sample Season: Spana 2012					
· • • • • • • • • • • • • • • • • • • •						

Sample Information							
Sample ID	Collection			Sample	B	Collector	
	Date	Time	Method	Туре	Preservative	Initial	QAO
SER-1	ZEMO IZ	12.55	KN	Benthic	<i>हर</i> ७ स	HV	
SFP-Z	28 mar 12	1056	KN	Benthic	ЕТОН	HV	
RC - 1	28/Mar 12	1204	KN	Benthic	ELOH	HU	
Sc - 1	28 (na/2	1146	μN	Berthir	ETOH	HV	. '-
GF -1	78 Mar 12	ପ୍ରମୟ ପ	KU	Bonthic	ETOH	H√	
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	Comments	
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Custody Information								
Relinquished			Accepted					
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	,							
				·				

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

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STREAM NAMESONIA	LOCATION					
STATION #SER-	STREAM CLA	ASS				
	ONG	RIVER BASIN	1			·
STORET#		AGENCY			<u> </u>	
INVESTIGATORS 7	PT HU JR					· .
FORM COMPLETED BY		DATE 75 MO	<u>√1</u> 2 м €	D REASON F	OR SURVEY	
WEATHER CONDITIONS	inain Ci ahow %Ci %	m (beavy min) 1 (strady min) 25 (interinition) 36 (interinition) 36 (cloud cover 36 (cloud cover	Past 24 hours O	□Yœ □	ea a beavy rain i No ture <u>() C</u> ° C	n the last 7 days?
SITE LOCATION/MAR	Draw a map of the	ite and indicate t	he areas sam;	pled (or attach	a photograph)	
	·.			·		
	LAT	37'03".9	54		•	•
	LONG	82 41 6	เขา		•	
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	PI	rotas			· · · · · · · · · · · · · · · · · ·	
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O Spring-fed
Mixture of origins
Other____

Stream Subsystem

Perennial U Intermittent U Tidal

Stream Origin

Clacial

Non-glacial montane
Swamp and bog

STREAM CHARACTERIZATION Stream Type

□ Warmwater

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

			<u>. </u>						
WATEI FEATU	RSHED RES	O Fig.	oniu at Surrounding L est C Com id/Pasuro C Indus ricultural S Other idential	mercial trial	Local Watershed NP: id No evidence So Obvious sources Local Watershed Erc None Z-Modersh	nsinu			
RIPARI VEGET (18 met	IAN ATION er buffer)		nte the dominant type is cs	nd record the Shrubs	dominant species present	Herbaceous			
INSTRE FEATU			ated Reach Length	m m	Canopy Cover] .		
		Area	ling Reach Area in km² (m²x1000) atod Stream Depth	m² km² m	High Water Mark Proportion of Reach Morphology Types A Riffle 30 % Pool%	m Represented by Stream □ Run(0%			
	· .		ce Velocity Liweg)	m/sec	Channolized Dyes Dem Present Dyes	· .			
LARCE WOODY LWD m² DEBRIS Demaity of LWD				m²/km² (LWD	/reach area)		1		
AQUATI VEGETA	IC ATION		Indicate the dominant type and record the dominant species present Rooted emergent Rooted submergent Rooted floating Floating OFree floating Attached Algae						
		doimin	ant species present		·				
		Portio	n of the reach with aqui	ntic vegetation	%	· -			
WATER	QUALITY .	Specifi Dissolv	ersture <u> 5 4 ° C</u> le Conductance <u>7070</u> yed Oxygen		•	rage Chemical Other			
•		рн <u>7</u> Turbid	<u> </u>		Water Surface Offs □ Slick □ Sheen □ □ None □ Other				
		WQ In	strument Used	<u> </u>	Turbidity (if not meass St Clear II Slightly to II Opaque II Stained	Turbidity (if not measured) Clear Slightly turbid Turbid Clear Stained Other			
SKDIME SUBSTR		Odorn O Norn O Chen SLOthe	nical Anserobic	D Petroleum D None	Deposits Studge C Sawdust Relief shells	☐ Paper fiber ☐ Sand Other	Left descending bank full		
· · ·	<u>,</u> i	Oila Of Abec	nt 🗆 Slight 🗀 Moders	ste □ Profiz	ATTYTON TRACESTARE MARK	h are not desply embedded, ik in color?	OF Ican Floc		
	(abould a	TRATE	COMPONENTS (80%)		ORGANIC SUBSTRATE C	OMPONENTS up to 100%)]		
Substrate Diameter % Composition in Sampling Reach		Substrate Type	Substrate Characteristic % Compositio		1				
Sedrock .			Detritus	sticks, wood, coarse plant		1			
Boulder			30		materials (CPOM)				
Cobble	64-256 mm (2.5		15	Muck-Mud	black, very fine organic (FPOM)		1		
havel	2-64 mm (0.1"-2	,	45						
and Silt	0.06-2mm (gritty 0.004-0.06 mm			Meri	grey, shell fragments				
1114	O'OOA-O'OO DDD	٠		1	1 .		I		

Clay

< 0.004 mm (slick)

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAMNAME South Ferk of the Point	LOCATION
STATION # SF9 - Z RIVERMILE	STREAM CLASS
LAT LONG	RIVER BASIN
STORET#	AGENCY
INVESTIGATORS TOT HU DR	
FORM COMPLETED BY	DATE LEME 12 REASON FOR SURVEY TIME 1:00 AM MA

	Habitat		Condition	Category	
ļ	Parameter	Optimal	Suboptimal	Marginal	Poor
	Careater than 70% of substrate favorable for opifismal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not trunsient).		40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat, lack of habitat is obvious; substrate unstable or lacking.
	SCORE 17				
sompling reach	2. Embeddedness	Gravel, cobble, and boulder particles are 0- 25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25- 50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50- 75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
퍨	SCORE 6				
Parameters to be evaluated in sempling reach	3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast- shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually alow-deep).
Ę	score 15				
Par	4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	score 13			A businessia but to a consistent	
	5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
'	SCORE 19				

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Habitat Parameter	Habitat		Conditio	n Category	
ļ		Optimal	Suboptime)	Marginal	Poor
	6. Channel Aiteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabios or coment; over 80% of the stream reach channelized and diarupted. Instream habitat greatly altered or removed entirely,
Ŀ	SCORE 17		D-44-42-4	1	
	7. Frequency of Riffics (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distrace between riffles divided by the width of the stream is a ratio of >2.5.
£	SCORE 16				
N of	i. Bank Stability score each bank) Note: determine left or right side by acing downstream, accore (LB)	Banks stable; evidence of crosion or bank failure absent or minimal; little potential for fluture problems. <5% of bank affected.	Moderately stable; infrequent, small areas of crosson mostly healed over. 5-30% of bank in reach has areas of crossion.	Moderately unstable; 30- 60% of bank in reach has areas of crosson; high exosion potential during floods.	Unstable; many croded areas; "raw" areas frequent along straight sections and bends; obvious bank alonghing; 60-100% of bank has evosional scars.
	CORE K (RB)				
P	Vegetative rotection (score ach bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	CORB <u>(7</u> (LB) CORB <mark>(7</mark> (RB)			erenga de la casa de la	
Vi W ba	. Riparian egetative Zone fidth (score each nk riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking iots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riperian zone 12-18 meters; human activities bave impacted zone only minimally.	12 meters; human activities have impacted	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
	ORE <u>5</u> (LB)			" :	
SC	CORE \O (RB)				

Total Score 159

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME SOUTH FOIK BUNG	LOCATION		
STATION# SFP-1 RIVERMILE	STREAM CLASS	<u> </u>	
LAT LONG	RIVER BASIN		
STORET#	AGENCY BMI	· · ·	
INVESTIGATORS			· .
FORM COMPLETED BY	DATE 28MAYLY TIME 1656 AM I	REASON FOR SURVEY	

WEATHER CONDITIONS	Now Storm (heavy rain) rain (steady rain) showers (intermittent) %cloud cover clear/sunny	Past 24 Has there been a heavy rain in the last 7 days? O Yes ONO Air Tamperature 65 ° C Other O
SITE LOCATION/MAP	Draw a map of the site and indicate	the areas sampled (or attach a photograph)
	Photos	
	361-30	<i>L1</i>
		о _ю
STREAM CHARACTERIZATION	Stream Subsystem SPerennial Clintermittent Clin	Stream Typo Fidal S-Coldwater
CONTRACTOR A STREET, AND IT	Streem Origin	Catchment Areakm² re of origins

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATE	ershed Ures	Pred DFo QFu QAs	ominant Surround rest U skl/Pasuro G picultural C aidential	ling Landuse Commercial Industrial Other	Local Watershed N O No evidence K S Obvious sources	ome potential sources	
	,	U Ro	aidential		Local Watershed Er	roalon te 🖸 Heavy	
RIPAR VEGE (18 me	UAN TATION ter buffer)	India domi	rate the dominant res nant species prese	type and record the U Shrubs art	dominant species present		
INSTR FEATU	EAM URES	Estin Estin	nated Reach Long nated Stream Wide ling Reach Area	thm thm	Canapy Cover Pedly open Care High Water Mark		
		Estim Sur-f	in km² (m²x1000) asted Stream Dept cc Velocity alweg)	hm	Morphology Types ☐ Riffic ☐ Pool% Channelized ☐ Ye	a □ No	
LARGI DEBRI	E WOODY	LWD		m²/km² (LWI	Dam Present DY	es Ci No	
AQUAT VEGET	TIC VATION	Indicate the dominant type and record the dominant species present Rooted emergent Rooted submergent Rooted floating Pree floating dominant species present					
	· · · · · · · · · · · · · · · · · · ·	Fortion of the reach with aquatic vegetation 20%					
WATER	WATER QUALITY		c Conductance \(\frac{1}{2}\) The d Oxygen \(\frac{1}{2}\)	<u>887</u>	Water Odors Normal/Nome C Sevential Petroleum Fishy Water Surface Oils	wage G Chemical O Other	
		Turbid	8,1 <u>0</u>	·	O Slick O Shoon SNone O Other		
<u></u>		WQ L	strument Used		Turbidity (if not meas sel Clear Slightly to Opaque Stained	oured) Orbid D Tarbid O Other	
SEDIME SUBSTR	NT/ ATE	STANGER Deposits			☐ Paper fiber ☐ Sand		
<u></u>		Oile DA.Abser	at □ Slight □ M	Ioderate 🗆 Profi	Looking at stones white are the undersides blue ise No	ch are not deeply embedded, ck in color?	
IN	ORGANIC SUBS	TRATE	COMPONENTS		ORGANIC SUBSTRATE (YARADAYAYII MARA	
Substrate Type	Туре		% Composition Sampling Res	n in Substrate	Characteristic	% Composition in Sampling Area	
Bedrock			<u> </u>	Detritus	sticks, wood, coarse plant	Sampling Area	
Boulder	> 256 mm (10")		150%		materials (CPOM)		
Cobble	ravel 2-64 mm (0.1"-2.5")		40.4	Muck-Mud	black, very fine organic		
Gravel					(FPOM)		
Sand	0.06-2mm (grltty		187/0	Mari	grey, shell fragments		
Silt	0.004-0.06 ппп		5°6				
Clay	< 0.004 mm (slic	<u>(t)</u>					

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME South Fork Pound	LOCATION	
STATION#SP-2 RIVERMILE	STREAM CLASS	
LATLONG	RIVER BASIN	
STORET#	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE AM PM	REASON FOR SURVEY

Г	Habitat		Condition	1 Category	
	Parameter	Optimal	Suboptimal	Marginal	Poor
	1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifannal colonization and fish cover; mix of snags, submerged loga, undercut benks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags)	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or locking.
		that are <u>not</u> new fall and not transient),	colonization (may rate at high end of scale).		
	SCORE)7				
sempling reach	2. Embeddedness	Gravel, cobble, and boulder particles are 0- 25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25- 50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50- 75% surrounded by fine acdiment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
ted In	score 6				7
Parameters to be evaluated in sampling reach	3. Velocity/Depth Regime	All four velocity/depth regimes present (slow- deep, slow-shallow, fast- deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast- shallow or alow-shallow are missing, score low).	Dominated by I velocity/ depth regime (usually slow-deep).
aran.	SCORE 10				
4	4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in har formation, mostly from gravel, sand or time sodiment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected, sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost abscut due to substantial sediment deposition.
	SCORE 17				
	5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	SCORE (9				

	Habitat		Condit	ion Category	
ĺ	Parameter	Optimal	Saboptimal	Marginal	Poor
	6. Channel Alteration	Chamelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not	Channelization msy be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabior or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
	SCORE 15	Name of the original states	present	nd start yet	
	7. Frequency of Riffles (or bends)	Occurrence of niffles relatively frequent; ratio of distance between riffles divided by width of the stream :1 (generally 5 to 7); variety of habitat is</td <td>Occurrence of riffles infrequent, distance between riffles divided by the width of the stream is between 7 to 15.</td> <td>Occasional riffle or bend; bottom contours provide some habitet; distance between riffles divided by the width of the stream is botween 15 to 25.</td> <td>shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a</td>	Occurrence of riffles infrequent, distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitet; distance between riffles divided by the width of the stream is botween 15 to 25.	shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a
mpling reach	SCORE 20	key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.		556Week 13 ii 23.	ratio of > 25.
₩. ₩	STORE 22		_ <u></u>		
Farameters to be evaluated broader than sampling reach	8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly hoaled over. 5-30% of bank in reach has areas of crosion.	Moderately unstable; 30- 60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many croded areas; "raw" areas frequent along straight sections and bends; obvious bank skoughing; 60-100% of bank has
ers to be e	SCORE 10 (LB) SCORE 9 (RB)				erosional acurs.
Parameter		More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shruts, or nonwoody reacrophytes; vegetative disruption through grazing or nowing minimal or not evident; almost all plents allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-haif of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
- 4	SCORE <u>10</u> (LB) SCORE 4 (RB)	1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1		T.C., prof. Co., septem Joseph	e je gjener pe i sa negori i saka e - m saka ja senja i saka ja senja ji sa
	10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., perking lots, roadheds, clear-cuts, lawns, or crope) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riperian zone 6- 12 meters; human activities have impacted zone a great deal.	Width of riparisn zone <6 meters: little or no riparian vegetation due to human activities.
	SCORE $\mathcal{O}_{(RB)}$				

Total Score _ 15/

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

		T COCIA TOTOLI			
STREAM NAMEShor#		LOCATION	·		
2 2 7 7 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	VERMILE	STREAM CLASS			
	NG	RIVER BASIN			
STORET#	·	AGENCY			
INVESTIGATORS		i 20 #	2017	THE A GOOD FROM STATES	
FORM COMPLETED BY	•	DATE 28 Mort	M PM	REASON FOR SURVEY	'
WEATHER CONDITIONS	Now		hours	Has there been a heavy rain	n in the last 7 days?
	D rażn	(hoavy rain) (steady rain)		Air Temperature 65 °C	
	C) shower %C) %c	s (intermittent) loud cover	o %	Other	· · · · · · · · · · · · · · · · · · ·
2.	& ci	car/sunny	0		
SITE LOCATION/MAP	Draw a map of the sk	te and indicate the	e areas anmpl	led (or attach a photograph)	· ·
	·	•			
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STREAM CHARACTERIZATION	Stream Subsystem	termittent 🕒 Tid	lal .	Stream Type Cl Coldwater Cl Warmwe	ster
	Stream Origin Glacial Non-glacial montau Swamp and bog	O Spring-fe O Mixture o	of origins	Catchment Area	_km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATE) FEATÚ	rshed Res		ominant Surrounding L rest Comm sld/Pasture Indus ricultural Sother sidential	anduse mercial strial r / Coud	Local Watershed NP SI No evidence CI So CI Obvious sources Local Watershed Er	osion	
	V				U None SI Moderat	te Cl Heavy	
RIPARI VEGET (18 met	IAN ATION er butter)	Legic O Ind domi	Lightcate the dominant type and record the dominant species present (I Shubs Gaises Herbaccons dominant species present				
INSTRI	EAM		nated Reach Length	,			
FEATU			nated Stream Width		Canopy Cover	rtly sheded 🗷 Shaded	
		4		<u></u> 10 m²	High Water Mark	m	
			_	m- km³ ·	Proportion of Reach	Represented by Stream	
	•	4			Marphology Types A Riffle 15 % El Pool 75 %	□ Run%	
		1 _	inted Stream Depth				
		(at the	alweg)	_m/scc		a □No	
T 4 70 000				<u></u>	Dam Present Q Ye	≰ ÇAÇNo	
DEBRIS	WOODY	LWD Densi		m²/km² (LWD	√reach area)		
AQUAT	IC	Indica	te the dominant type ex		fominant species present	<u> </u>	
VEGET/	ATION	□ Roc	ated emergent	Rooted submer	gent C Rooted floating	☐ Free floating	
			ant species present	_			
:			Portion of the reach with aquatic vegetation%				
WATER	QUALITY		ersture 14.3 °C				
		Specif	le Conductance Z63 ved Oxygen		Water Odors SNumalNone Sewage Petroleum Chemical Fishy Other		
		рЖ <u>7</u>	.18		Water Surface Offic O Slick O Sheen (XNone O Other	Olobs OFficia	
			lityustrument Used		Turbidity (if not meas Clear D Slightly to Opaque D Stained		
SEDIME) SUBSTR	NTI/ ATTE	Ottors VINOM O Chen O Othe	nal 🖸 Sewage nical 🖨 Apacrobic	Petroleum None	Deposits □ Sludge □ Sawdust □ Reliot shells	O Paper fiber O Sand	
· .		Offic Abso	nt □ Slight □ Modern	te C) Profit	are use opposition his	ch are not deeply embedded, ak in color?	
INC	ORGANIC SUBS	TRATE	COMPONENTS		ORGANIC SUBSTRATE C	OMPONENTS	
ubstrate Type			Substrate Type	Characteristic	% Composition in Sampling Area		
edrock			<u> </u>	Detritus	sticks, wood, course plant	County of Mark	
oulder	> 256 mm (10")		30	1	materials (CPOM)		
obble	64-256 mm (2.5°	'-10")	60	Muck-Mud	black same fine area la		
ravel	<u> </u>		10	***************************************	black, very fine organic (FPOM)	·	
md	0.06-2mm (gritty)			Marl	con chall for		
lt l	0.004-0.06 mm				grey, shell fragments	.`	

A-6

HABITAT ASSESSMENT FIELD DATA SHEET-HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Short Creck	LOCATION			
STATION # SC- RIVERMILE	STREAM CLASS			
LAT LONG	RIVER BASIN			
STORET#	AGENCY			
INVESTIGATORS TOT HV JR				
FORM COMPLETED BY	DATE LEMBON FOR SURVEY TIME // CD AM PM			

Г	Habitat		Condition	ı Category	
	Parameter	Optimal	Suboptimal	Marginal	Poor
	Creater than 70% of substrate favorable for opifannal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags) that are not new fall and		40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
•	SCORE 18	not transferst).	high end of scale).		
sempling reach	2. Embeddedness	Gravel, cobble, and boulder particles are 0- 25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobbie, and boulder particles are 25- 50% surrounded by fine sediment,	Gravel, cobble, and boulder particles are 50- 75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
7	SCORE 19		The second of the second of		
Parameters to be evaluated in sempling reach	3. Velocity/Depth Regime	All four velocity/depth regimes present (slow- deep, slow-shallow, fast- deep, fast-shellow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast- shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
T I	SCORE				
d	4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, send or fine sediment; 5-30% of the bottom affected; alight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools provalent.	Heavy deposits of fine material, increased ber development; more than 50% of the bottom changing frequently; pools almost absent this to substantial sediment deposition.
	SCORE 16			10 10 10 10 10 10 10 10 10 10 10 10 10 1	
	5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	SCORE 18				

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Γ	Habitat		Conditi	on Category	
	Parameter	Optimal	Subortimal	Marginal	Poor
	6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some chamelization present, usually in areas of bridge ebutments; evidence of past chamelization, i.e., dredging, (greater than past 20 yr) may be present, but recent chamelization is not present.	Chamelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or coment; ever 80% of the stream reach charmelized and disrupted. Instream habitat greatly altered or removed entirely.
ľ	SCORE 12		A STATE OF THE STA	er <mark>ek er </mark>	
sampling reach	7. Frequency of Riffles (or beads) Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.		Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
i sampl					
Perameters to be evaluated broader than	8. Bank Stability (score each bank) Note: determine left or right side by facing downstream. SCORE 7 (LB)	Banks stable; evidence of crosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of crosion mostly healed over, 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of crosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scers.
rr to be	SCORE S (RB)				4
Paramete	9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented, disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-balf of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	score <u>S</u> (lb) score <u>R</u> (rb)				
	10. Riparian Vegetativo Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-carts, lawns, or crops) have not impacted zone.	Width of riperien zone 12-18 meters; human activities have impacted zone only minimally.	12 meters; human activities have impacted	Width of riperian zone <6 meters: little or no riperian vegetation due to human activities.
	SCORE (LB) SCORE (RB)		And the second of the second o		

Total Score 138

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME Rat C	rell	LOCATION	· ·		<u> </u>		
	VERMILE	STREAM CLASS					
·	NG	RIVER BASIN			<u> </u>		
STORET#	+./	AGENCY	, .				
INVESTIGATORS PT	- 41 2 ZX	7.	4.57				
PORM COMPLETED BY		DATE 28M & TIME 720 4	- 10/2 - AM (A)	REASON FOR SURVEY			
							
WEATHER CONDITIONS	Now		Past 24 hours	Has there been a heavy rain	in the last 7 days?		
	. 🔾 storm	n (heavy min)		Air Temperature 65 °C			
	🗀 shower	(steady rain) ra (intermittént)	=	Other	·		
		cloud cover lear/sumny	<u></u> %		1		
SITE LOCATION/MAP		te and indicate th	e aress sampl	led (or attach a photograph)	,		
	· ·				_		
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	110105	ع/ح <i>د</i> ر	10				
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	<u> </u>	·			<u> </u>		
STREAM CHARACTERIZATION	Stream Subsystem O Perennial O Int	termittent 🗅 Tid	ial \	Stream Type	÷.		
	Stream Origin Glacial Non-glacial montan Swamp and bog	O Spring-fe O Mixture o O Other	ed of origins	Cutchment Area	_km ^z		

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATEI FRATU	rshed Tres		:kd/Pasture 🗆 Indus	nercial	Local Watershed NK WNo evidence OSo Obvious sources Local Watershed Er	nue potential sources		
RIPARI VEGET (18 met	IAN FATION er buffer)		nte the dominant type is est	nd record the Shrubs	dominant species present			
Area in km² (m²x1000) Estimated Stream Depth			m² km²	Canopy Cover E.Partly open O.Pa High Water Mark Proportion of Reach Morphology Types O.Rifile S. % Channelized Mye	Represented by Stream Run 30 %			
		(at the	alweg)		Dam Present Cl Ye	· -7:- ·		
LARGE	WOODY	LWD Densi	m	m²/km² (LWD	/reach area)			
AQUATI VEGETA		□ Flow domin	ting Algae	Attached Algae	lominant species present Cl Rooted floating	O Free floating		
'		Yorno	n of the reach with aqui	ide vegetadon	<u></u> %			
WATER	QUALITY	Temperature 16.2 °C Specific Conductance 1278 Dissolved Oxygen			,			
			<u>7,40</u> Iity		Water Surface Oils Slick I Shoon (None I Other	O Clobs O Mecks		
<u> </u>			strument Used		Tarbidity (if not mens Si Clear	oured) Orbid Turbid Other		
SEDIME: SUBSTR	NT/ ATE	Odors SANom Chen Cl Othe	nal ☐ Sewage nical ☐ Auserobic	□ Petroleum □ None	Deposits O Studge O Sawdust O Reliet shells	☐ Paper fiber ☐ Sand ☐ Other_		
		Oila D(Abse	ut □ Slight □ Modera	to □ Profu		ch are not deeply embedded, ck in color?		
ENC	ORGANIC SUBS	TRATE	COMPONENTS 100%)		ORGANIC SUBSTRATE (COMPONENTS		
Substrate Type	Diamete	r	% Composition in Sampling Reach	Substrate Type	Characteristic	% Composition in Sampling Area		
Bedrock	edrock			Detritus	sticks, wood, coarse plant			
Boulder	> 256 mm (10")		70%	1	materials (CPOM)			
Cobble	obble 64-256 mm (2.5"-		70 1/4	Muck-Mud	black, very fine organic (FPOM)			
Gravel	ravel 2-64 mm (0.1"-2.5"		10%	L	(FPOM)			
Sand	0.06-2mm (gritty)		Marl	grey, shell fragments			
Sift	iit 0.004-0,06 mm			· •	• ,			
Clay	_		· · · · · · · · · · · · · · · · · · ·		•			

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME ROLL CORELL	LOCATION
STATION# RC RIVERMILE	STREAM CLASS
LATLONG	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS TOT HV JR	
FORM COMPLETED BY	DATE ZS/No lo / 2. TIME AM _ *** REASON FOR SURVEY

Hal	h ita t	Condition Category						
	meter	Optimal	Suboptimal	Marginal	Poor			
1. Epifaur Substratz Avallable	/	Greater than 70% of substrate favorable for epifamal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat, lack of habitat is obvious; substrate unstable or lacking.			
		that are not new fall and not transient).	colonization (may rate at high end of scale).					
SCORE	17	and the second of the second			en de la companya de La companya de la co			
2. Embedd	ledness	Gravel, cobble, and boulder particles are 0- 25% surrounded by fine sediment. Layering of cobble provides diversity	Gravel, cobble, and boulder particles are 25- 50% surrounded by fine sodiment.	Gravel, cobble, and boulder particles are 50- 75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.			
<u> </u>		of niche space.						
SCORE	1.6							
2. Embedd 2. Embedd 3. Velocity Regime SCORE	/Осрth	All four velocity/depth regimes present (slow-deep, slow-shellow), fast-deep, fast-shellow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast- shallow or slow-shallow are missing, score low).	Dominated by I velocity/ depth regime (usually slow-deep).			
SCORE	17:							
4. Sedimen Deposition	' -	Little of no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; alight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost abscut due to substantial sediment deposition.			
SCORE	11	Litaria de	and the first of the second					
5. Channel Status	Flow	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.			
SCORE	19							

	Habitat		Condiți	on Category	
ł	Parameter	Optimal	Saboptimal	Marginal	Poor
	6. Channel Alteration	Channelization or dredging absent or minimal; streem with normal pattern.	Some chamelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yi) may be present, but recent channelization is not present.	Chamelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
ļ	SCORE 5		The second secon		and the second s
	7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where	Occurrence of riffics infrequent; distance	Occasional riffle or bend; bottom contours provide some habitst, distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat, distance between riffles divided by the width of the stream is a ratio of >25.
sampling reach		riffles are continuous, placement of boulders or other large, natural obstruction is important.			
(SE	SCORE		2	And the second s	
Parameters to be evaluated broader than	8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Backs stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of crosion mostly healed over, 5-30% of bank in reach has areas of crosion.	Moderately unstable; 30- 60% of bank in reach has areas of crosion; high erosion potential during flootla.	Unstable; many croded areas; "raw" areas frequent along straight sections and bends; obvious bank alonghing; 60-100% of bank has erosional sears.
n to be en	SCORE (LB)				erosional scars.
	9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory abrubs, or nonwoody macrophytes; vegetative disruption through grazing or nowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambunk surfaces covered by native vegetation, but one class of plants is not well-represented, disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vogetation; disruption obvious; patches of bare soil or closely cropped vogetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	SCORE G (LB)	2002 <u>/2</u> 000 100			
	10. Riparian Vegetative Zone Width (score each bank riparian zone)		Width of riperian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian 2000 6- 12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities,
	SCORE <u> 0</u> (LB)				
Ŀ	SCORE (RB)	<u> </u>			

Total Score 162_

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME GIA	dy fork	LOCATION	· · · · ·		<u> </u>	<u>, </u>	
STATION# GF-1	STREAM CLA	SS			<u> </u>		
	ONG	RIVER BASIN	·		· · · · · · · · · · · · · · · · · · ·		
STORET#		AGENCY					<u> </u>
INVESTIGATORS TO	T HV JR					<u> </u>	
FORM COMPLETED BY		DATE ZSMA TIMB <u>440</u>	2017 (A) PM		N FOR SURVEY		
THE A PRINT WITH	Now		Past 24	Has there	been a heavy rain	in the last	 t 7 days?
WEATHER CONDITIONS	L .	- (1	hours		been a heavy rain U No	,	
	C rain	n (heavy rain) (steady rain)	a	Air Temp	eratare <u>58</u> °C		
	%□ %	rs (intermittent) cloud cover	<u> </u>	Other	· · · · · · · · · · · · · · · · · · ·	· · ·	
<u> </u>	, pr	lear/sumny		<u> </u>			
SITE LOCATION/MAP	Draw a map of the s	ite and indicate ti	ie areas samį	led (or atta	ch a photograph)		
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C Spring-fed
Mixture of origins
Other____

Stream Subsystem

O Perennial O Intermittent O Tidal \(\sigma \)

Stream Origin

Glacial

Non-glacial montane

Swamp and bog

STREAM CHARACTERIZATION Stream Type

□ Warmwater

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATE FEATI	RSHED URES	H A	ominant Surrounding vest GCo GldPasturo Gind gricultural GO sudeotial	Landuse nmercial ustrial ner	Local Watershed NPS Pollution No evidence Some potential sources Obvious sources Local Watershed Erosion None Moderate Heavy	
RIPAR VECE (18 mer	tian Pation ter buffer)		este the dominant type ses mant species present		dominant species present	
înstr Featu	EAM TRES	Estin S≖mj	usted Reach Length nated Stream Width pling Reach Area in km² (m²x1.000)	m	Canopy Cover Partly shaded Shaded High Water Mark Proportion of Reach Represented by Stream	
	_	Rstin Surfs	nated Stream Depth ICE Velocity Silveg)	ш.	Morphology Types Skriffle 10 % Krum 40 % Pool — % Channelized □ Yes SkNo Dam Present □ Yes No	
LARGE	S WOODY	LWD Demsi	ty of LWD	_m²/km² (LWI		
AQUAT VEGET		Indica C) Roc C) Flor domin	ate the dominant type : Eed emergent sting Algae stant species present	and record the LRooted submer (Attached Algae	dominant species present gent — D Rooted floating — D Free floating	
WATER	QUALITY	Tempo Specif Dissol	on of the reach with aquerature 12.7°C ic Conductance 52.	<u> </u>	Water Odors MNome O Sewage Petroleum O Chemical Fishy O Other Water Surface Othe	
		Turble	.O.S_ lity strument Used	·	Slick OSbeen OGlobs OFfecks None Other Turbidity (if not measured) Clear OSlightly turbid OTurbid Opsque OStained	
SEDIME SUBSTR	NT/ ATE	Odors Si Norr Chen Cibe Othe Offa Abse	nal O Sowage nical O Anacrobic T Mode	□ Petroleum □ None	Deposits Studge Sawdnet Paper fiber Sand Relict shells Other Looking at stones which are not deeply embedded, ap the undersides black in color?	
INC	ORGANIC SUBS	TRATE	COMPONENCE		ORGANIC SURSUPATE COMPONENTS	
Substrate Type			% Composition in Sampling Reach	Substrate Type	(does not necessarily add up to 190%) Characteristic % Composition in Sampling Area	
Boulder Control	Boulder > 256 mm (10") Cobbie 64-256 mm (2.5"- Gravel 2-64 mm (0.1"-2.5 Sand 0.06-2mm (gritty) Silt 0.004-0.06 mm		Detritor S		sticks, wood, cosuse plant materials (CPOM)	
Gravel Sand			2-64 mm (0.1"-2.5") 0		Muck-Mud	black, very fine organic (FPOM)
Silt Clay				Meri	grey, shell fragments	

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME GLACK FORK	LOCATION	
station # GF-1 rivermile	STRBAM CLASS	
LATLONG	RIVER BASIN	
STORET#	AGENCY	
INVESTIGATORS TOT HV JR		
FORM COMPLETED BY	DATE 28 Mar 20 12 REASON FOR SURVEY TIME 9:40 OF PM	

Г	Habitat		Condition	n Category	
	Parameter	Optimal	Suboptimal	Marginal	Poor
	1. Epifaunal Substrate/ Available Cover	Greater then 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut benks, cobble or other	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
		stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).		
	SCORE 8				
sampling reach	2. Embeddedness	Gravel, cobble, and boulder particles are 0- 25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25- 50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50- 75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
A d	score 14				
Parameters to be evaluated in eampling reach	3. Velocity/Depth Regime	All four velocity/depth regimes present (slow- deep, slow-shallow, fast- deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast- shallow or slow-shallow are missing, score low).	Dominated by I velocity/ depth regime (usually slow-deep).
COE.I.	score 15				
T.	4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	SCORE 12.				
	5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	SCORE 19		7.7.1. 7.7.4.5 3.5		

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

1	Habitat		Conditi	ion Category	
ŀ	Parameter	Optimal	Suboptimal	Marginal	Poor
	6. Channel Alteration	Chamelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abuments; evidence of past channelization, i.e.,	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream	Banks shored with gabic or cement; over 80% of the stream reach champelized and disrupted. Instream
! !		311.2	dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	reach channelized and disrupted	habitat greatly altered or removed entirely.
l	SCORE 5				
	7. Prequency of Riffles (or bends)	Occurrence of riffics relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Ownerally all flat water of shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
mpiing reach	score 19	key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.			
H	BCOICE 1				
Parameters to be evaluated broader than sampling reach	8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of crosien or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of crosion.	Moderately unstable; 30- 60% of bank in reach has areas of erosion, high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight acctions and bends; obvious bank sloughing; 60-100% of bank has
rs to be ev	SCORE (LB) SCORE (RB)				erosional scars.
	vana vana,	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or conwoody macrophytes; vegetative disruption through grazing or nowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the atreambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-balf of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 continueters or less in average shibble height.
	SCORE (1 (RB)			e antage for onjuration of the	
	10. Riparian Vegetative Zone Width (score each bank riparian zone)	>18 meters; human activities (i.e., parking	Width of riperian zone 12-18 meters; human scrivities have impacted zone only minimally.	activities have impacted	Width of riperian zone <6 meters: little or no riperian vegetation due to human activities.
	scorb <u>//</u> (lb) scorb <u>/</u> (rb)				

Biological Monitoring, Inc. VASCI Benthic Macroinvertebrate Metric Spreadsheet

		- t				.1.6		ľ	Station ID			SFP-1	
		Client		R	ted River Co		<u>y</u>		Stream Na		Sar	th Fork Po	und
		Facility			BI							Spring 201	
		Project l	Vumber	ì	38	86		L	Sample Se	ason		Spring 201.	<u></u>
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		Client	F	Red River C	oal Compa	ny
		Facility			Ml	К
		Project Number			886	
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Client	Red River Coal Company
Facility	ВМІ
Project Number	3886

Station ID	SFP-I
Stream Name	South Fork Pound
Sample Season	Spring 2012



Spring 2012

Trichoptera

Brachycentridae Calamoceratidae Glossosomatidae Helicopsychidae Hydropsychidae Hydroptifidae Lepidostomatidae Leptoceridae Limnephilidae Odontoceridae Philopotamidae Phryganeidae Polycentropodidae Psychomyiidae Rhyacophiloidea Talitridac Uenoidae

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Other Taxa

Amphipoda Ancylidae Annelida Arachnida Asellidae Atractideidae Branchiobdellidae Cambaridae Collembola Corbiculidae Decapoda Gammaridae Gastropoda Hirudinidae Hydrobiidae Hydracarina Isopoda Nematoda Nemerterea Oligochaeta Pelecypoda Physidae Planariidae Planorbidae Pleuroceridae Sphaeriidae

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Client	Red River Coal Company
Facility	BMI
Project Number	3886



Station ID	SFP-1
Stream Name	South Fork Pound
Sample Season	Spring 2012



Abundance
Number of Taxa
Number of EPT Taxa
Percent E
Percent PT Less Hyd.
Percent Scrapers
Percent Chironomidae
Percent Two Dominant

Hilsenhoff Biotic Index

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VASCI Metrics vs Standard

Number of Taxa	22.73
Number of EPT Taxa	9.09
Percent E	0.00
Percent PT Less Hydropsychidae	0.00
Percent Scrapers	0.00
Percent Chironomidae	10.91
Percent Two Dominant	7.88
Hilsenhoff Biotic Index	59.49

VASCI Scoring

Raw VASCI (Metrie vs Standard)
Final VASCI	(Metric Truncation 0-100)

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Г	13.76	Ī

Other Metrics

Abundance Percent Ephemeroptera Percent Plecoptera Percent Trichoptera

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Mean and Std. Dev.

Number of Taxa
Number of EPT Taxa
Percent E
Percent PT Less Hydropsychidae
Percent Scrapers
Percent Chironomidae
Percent Two Dominant
Hilsenhoff Biotic Index

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Biological Monitoring, Inc. VASCI Benthic Macroinvertebrate Metric Spreadsheet

	Client	Red River C	oal Company	Station ID	SFP-2a	
	Facility	ВМІ		Stream Name	South Fork Pound	
	Project Number	3886		Sample Season	Spring 2012	
	r roject Number	30	100	Campic Stason	Spring sv.	
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	Client	Red River Coal Compan	y Station ID	SFP-2a
	Facility	BMI	Stream Name	South Fork Pound
•	Project Number	3886	Sample Season	Spring 2012
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Peltoperlidae				
Perlidae				
Perlodidae			4	4

Pteronarcyidae Taeniopterygidae

Client	Red River Coal Company
Facility	ВМІ
Project Number	3886

Station ID	SFP-2a
Stream Name	South Fork Pound
Sample Season	Spring 2012

Majarti takataran er es es

Sample Season	Spring 2012
PPP AND DRIVE DESIGNATION OF A SECTION OF A	

Trichoptera

Brachycentridae Calamoceratidac Glossosomatidae Helicopsychidae Hydropsychidae Hydroptilidae Lepidostomatidac Leptoceridae Limnephilidac Odontoceridae Philopotamidae Phryganeidae Polycentropodidae Psychomyiidae Rhyacophiloidea Talitridae

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Other Taxa

Uenoidae

Amphipoda Ancylidae Annelida Arachnida Asellidac Atractideidae Branchiobdellidae Cambaridae Collembola Corbiculidae Decapoda Gammaridae Gastropoda Hirudinidae Hydrobiidae Hydracarina Isopoda Nematoda Nemerterea Oligochaeta Pelecypoda Physidac Planariidae Planorbidae

Pleuroceridae Sphaeriidae Turbellaria

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Client	Red River Coal Company		
Facility	ВМІ		
Project Number	3886		

Station ID	SFP-2a		
Stream Name	South Fork Pound		
Sample Season	Spring 2012		





Abundance
Number of Taxa
Number of EPT Taxa
Percent E
Percent PT Less Hyd.
Percent Scrapers
Percent Chironomidae
Percent Two Dominant
Hilsenhoff Biotic Index

Manyleth constant	Appropriate Appropriate of			#0160M010000000	
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VASCI Metrics vs Standard

Number of Taxa	22.73
Number of EPT Taxa	27.27
Percent E	0.00
Percent PT Less Hydropsychidae	22.25
Percent Scrapers	0.00
Percent Chironomidae	13.86
Percent Two Dominant	14.31
Hilsenhoff Biotic Index	63.48

VASCI Scoring

Raw	VASCI (Metric vs Standard)	
Final	I VASCI (Metric Truncation 0-100)	

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Other Metrics

Abundance				
Percent Ephemeropters				
Percent Plecoptera				
Percent Trichoptera				

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Mean and Std. Dev.

Number of Taxa
Number of EPT Taxa
Percent E
Percent PT Less Hydropsychidae
Percent Scrapers
Percent Chironomidae
Percent Two Dominant
Hilsenhoff Biotic Index

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Abundance				
Percent Ephemeroptera				
Percent Plecoptera				
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Biological Monitoring, Inc. VASCI Benthic Macroinvertebrate Metric Spreadsheet

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	Facility				MI 886		-					
	Project N	umber		38	886		J	Sample S	eason	<u> </u>	Spring 201	2
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	Client	Red River Coal (ompany	Station ID	SC-l Short Creek	
	Facility	BMI		Stream Name		
	Project Number	3886		Sample Season	Spring 2012	
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Sialidae						
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Leuctridae				10		
Nemouridae	ļ		i	1		
Peltoperlidae						
Perlidae						
Perlodidae				1		
Pteronarcyidae						

Taeniopterygidae

Client	Red River Coal Company
Facility	ВМІ
Project Number	3886

Station ID	SC-1
Stream Name	Short Creek
Sample Season	Spring 2012

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Trichoptera

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Brachycentridae
Calamoceratidae
Glossosomatidae
Helicopsychidac
Hydropsychidae
Hydroptilidae
Lepidostomatidae
Leptoceridae
Limnephilidae
Odontoceridae
Philopotamidae
Phryganeidae
Polycentropodidae
Psychomyiidae
Rhyacophiloidea
Talitridae
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Other Taxa

Taxa
Amphipoda
Ancylidae
Annelida
Arachnida
Ascllidae
Atractideidae
Branchiobdellidae
Cambaridac
Collembola
Corbiculidae
Decapoda
Gammaridae
Gastropoda
Hirudinidae
Hydrobiidae
Hydracarina
Isopoda
Nematoda
Nemerteres
Oligochaeta
Pelecypoda
Physidac
Planariidae
Planorbidac
Pleuroceridae
Sphaeriidae
Turbellaria

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Client Red River Coal Company		
Facility	, вмі	
Project Number	3886	

Station ID	SC-1
Stream Name	Short Creek
Sample Season	Spring 2012





Abundance
Number of Taxa
Number of BPT Taxa
Percent E
Percent PT Less Hyd,
Percent Scrapers
Percent Chironomidae
Percent Two Dominant
Hilsenhoff Biotic Index

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VASCI Metrics vs Standard

Number of Taxa	45.45
Number of EPT Taxa	54.55
Percent E	0.00
ercent PT Less Hydropsychidae	43,81
'ercent Scrapers	0.00
ercent Chironomidae	27,52
ercent Two Dominant	26,52
Hilsenhoff Biotic Index	70.29

VASCI Scoring

Raw VASCI (Metric vs Standard)	33.52
Final VASCI (Metric Truncation 0-100)	33.52

Other Metrics

Abundance
Percent Ephemeroptera
Percent Plecoptera
Percent Trichoptera

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109.00	109.00
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14,68	 14.68
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Mean and Std. Dev.

Number of Taxa
Number of EPT Taxa
Percent E
Percent PT Less Hydropsychidae
Percent Scrapers
Percent Chironomidae
Percent Two Dominant
Hilsenhoff Biotic Index

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Biological Monitoring, Inc. VASCI Benthic Macroinvertebrate Metric Spreadsheet

	Client	Red River Coal Company	Station ID	RC-1
	Facility	BMI	Stream Name	Rat Creek
	Project Number	3886	Sample Season	Spring 2012
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Tipulidae				
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	Client	Red River Co	oal Company	Station ID	RC-1	
	Facility		MI	Stream Name	Rat Creek	
				Sample Season	Spring 2012	
	Project Number	3886		Sample Scason	Spring 2012	
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Gerridae				<u> </u>	<u> </u>	
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Odonata		1 1				
Acshnidae					 	
Calopterygidae						
Coenagrionidac						
Cordulegastridae		<u> </u>				
Corduliidae						
Gomphidae					i l	
Lestidae	Ī	1			<u>i </u>	
Plecoptera					· · · · · ·	
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Capniidae/Leuctridae	1					
Chloroperlidae	1	<u> </u>				
Leuctridae	1			1	1	
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Peltoperlidae					<u> </u>	
Perlidae				Ī	1	
Periodidae						
Pteronarcyidae						
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Taeniopterygidae

Client	Red River Coal Company
Facility	BMI
Project Number	3886

Station ID	RC-1
Stream Name	Rat Creek
Sample Season	Spring 2012

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Trichoptera

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Other Taxa

Amphipoda Ancylidae Annelida Arachnida Asellidae Atractideidae Branchiobdellidae Cambaridae Collembola Corbiculidae Decapoda Gammaridae Gastropoda Hirudinidac Hydrobiidae Hydracarina Isopoda Nematoda Nemerterea Oligochacta Pelecypoda Physidae Planariidae Planorbidae Pleuroceridae Sphaeriidae

Turbellaria

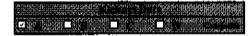
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Client	Red River Coal Company		
Facility	ВМІ		
Project Number	3886		

Station ID	RC-1
Stream Name	Rat Creek
Sample Season	Spring 2012





Abundance STORMS

Percent E
Percent PT Loss Hyd.
Percent Scrapers
Percent Chironomidae
Percent Two Dominant
Hilsenhoff Biotic Index

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VASCI Metrics vs Standard

Number of Taxa	22,73
Number of EPT Taxa	27,27
Percent (S	0,00
Percent PT Less Hydropsychidae	5,56
Percent Scrapers	0.00
ercent Chironomidae	11.88
Percent Two Dominant	8,58
filsenhoff Biotic Index	60.43

VASCI Scoring

Raw VASCI (Metric vs Standard)	1
Final VASCI (Metric Truncation 0-100)	1

17.00	5
17.00	5

Other Metrics

Abundance
Percent Ephemeroptera
Percent Plecoptera
Percent Trichoptera

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0.00		0.00
1.98		1.98
5.94		5.94

Mean and Std. Dev.

Number of Taxa
Number of EPT Taxa
Percent E
Percent PT Less Hydropsychidae
Percent Scrapers
Percent Chironomidae
Percent Two Dominant
Hilsenhoff Biotic Index

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Abundance
Percent Ephemeroptera
Percent Plecoptera
Percent Trichoptera

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Biological Monitoring, Inc. VASCI Benthic Macroinvertebrate Metric Spreadsheet

	Client	Red River Coal Company	Station ID	GF-1
	Facility	BMI	Stream Name	Glady Fork
	Project Number	3857	Sample Season	Spring 2012
	r roject (vamber	3637	Sample Season	Spring 2012
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Dryopidae	!		1 ;	
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Haliplidae	i			
Hydraenidae	· · · · · · · · · · · · · · · · · · ·	 	· ·	
Hydrophilidae		 		
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Noteridae	 	 		
Psephenidae	 	 	l 	
Ptilodactylidae	.	- 	 	
Scirtidae	' 	<u> </u>		
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Staphylinidae	<u> </u>	<u> </u>		
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Diptera		· · · · · · · · · · · · · · · · · · ·	·	
Athericidae				
Blepharicerida				
Ceratopogonid	ae			
Chaoboridae				
Chironomidae			23	23
Culicidae				
Dixidae				<u> </u>
Dolichopodida	e		I	
Empididae			4	4
Ephydridae				
Muscida c			i i	
Phoridae	i		1 1	
Psychodidae	İ		l l	
Sciomyzidae			1	
Simuliidae			2	2
Stratiomyiidae				
Syrphidae				
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Ephemeroptera				
Ameletidae			1 . 1	· · · · · · · · · · · · · · · · · · ·
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Polymitarcyida	_	 	 	-
Potomanthidae		<u> </u>	 	-
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Tricorythidae			•	
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	Client	Red River (Coal Company	Station ID	GF-1	
	Facility	BMI 3857		Stream Name	Glady Fork Spring 2012	
	Project Number			Sample Season		
	1 Toject Ivalabel		007	cample creasur	Spring 2012	
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Hemlptera				VWW.WV-VALAPULATAVAA VALAMAA AAAAA AAAAA AAAAAA AAAAAA AAAAAA AAAA	MANANA MANANA MANANA MANANA MANANA MANANA MANANA MANANA MANANA MANANA MANANA MANANA MANANA MANANA MANANA MANANA	
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Corixidae			<u></u>	1		
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Lepidoptera				1		
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Pyralidae	 	<u> </u>	! 	1 	<u> </u>	
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Peltoperlidae	- 	-			- 	
Perlidae .	 					
Periodidae			1	2		
Pteronarcyidae		1		 	- 	
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Client	Red River Coal Company		
Facility	BMI		
Project Number	3857		

Station ID	GF-1
Stream Name	Glady Fork
Sample Season	Spring 2012

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Sample Season	Spring 2014			
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Trichoptera

Brachycentridae Calamoceratidae Glossosomatidae Helicopsychidae Hydropsychidae Hydroptilidae Lepidostomatidae Leptoceridae . Limnophilidae Odontoceridae Philopotamidae Phryganeidae Polycentropodidae Psychomyiidae Rhyacophiloidea Talitridac Uenoidae

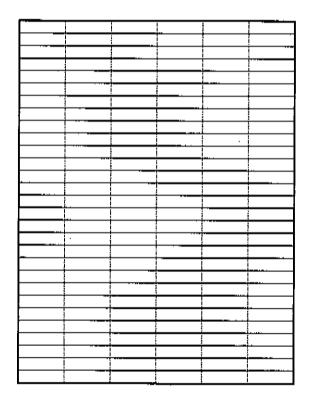
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Other Taxa

Amphipoda Ancylidac Annelida Arachnida Asellidae Atractideidae Branchiobdellidae Cambaridae Collembola Corbiculidae Decapoda Gammaridae Gastropoda Hirudinidae Hydrobiidae Hydracarina Isopoda Nematoda Nemerterea Oligochaeta Pelecypoda Physidac Planariidae Planorbidac Pleuroceridae

Sphaeriidae Turbellaria



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Client	Red River Coal Company
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Project Number	3857

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Station ID	GF-1
Stream Name	Glady Fork
Sample Season	Spring 2012



Abundance
Number of Taxa
Number of EPT Taxa
Percent E
Percent PT Less Hyd,
Percent Scrapers
Percent Chironomidae
Percent Two Dominant
Hilsenhoff Biotic Index

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7W7.000.1	water with the control of the contro	in our portion		ONE MODERN CONTRACTOR	/*************************************
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www.commission	320200000000000000000000000000000000000	Sea cracer cheese C	CONTRACTOR	erbitari etgeler	
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VASCI Metrics vs Standard

Number of Taxa	54.55
Number of EPT Taxa	72.73
Percent É	4.18
Percent PT Less Hydropsychidae	196.87
Percent Scrapers	0.00
Percent Chironomidae	80.34
Percent Two Dominant	27.17
Hilsenhoff Biotic Index	102.44

VASCI Scoring

Raw VASCI (Metric vs Standard)	
Final VASCI (Metric Truncation 0-100)	

 67.28
54.87

Other Metrics

Abundance Percent Ephemeroptera Percent Plecoptera Percent Trichoptera

117.00		117.00
2.56	<u> </u>	2,56
68.38		68.38
3.42		3.42

Mcan and Std. Dev.

Number of Taxa
Number of EPT Taxa
Percent E
Percent PT Less Hydropsychidae
Percent Scrapers
Percent Chironomidae
Percent Two Dominant
Hilsenhoff Biotic Index

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Abundance
Percent Ephemeroptera
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Stream: 500+1	FORK PO	ound)ate:
Station: SFP-	<u> </u>				
Description:				1116	
Time Begin:					
Observers:		Stream W	idth*:	Section Widt	h (W):
Observations:					
Section Midpoint	Section Depth	ลาวการ จะกระสายสมอังกระทำ และสายเกาะสาย เสียง เสียง	Velocity (V)		Flow (C)
(ft)(m)	(ft) (m) (cm)	Depth**	At Point	Average	(m²/s) (ft²/s)
	(D)	(ft)(m)	(ft/s)(m/s)	(ft/s)(m/s)	Q = (W)(D)(V)
		Land Company Company	engerente, artikon det nasta ajraktioners entreatta.	dispersional company of the	
3,5	٥.32		1,5		0.48
4,5	D.30		1.5		0.45
5,5	0.2		G,5		0.1
6.5	0.45		3.0		1,95
7.5	0.98		3.5		3,43
8,5	1.16		3.5		4.06
9,5	1,2		3,5		4.2
10.5	0.42		2.5		2,3
11.5	ರಿ, 8		7. 5		2
12.5	0.2	· · · · · · · · · · · · · · · · · · ·	0,5		0.\
13,5	0.18		Õ		Ò
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Stream: <u>Soいけん</u>	Hork Yound				Date: <u> 7 X Mw ch 201</u> 2
Station: <u>SFP</u>	<u>- Z</u>				
Description:				l u	
	Time End:			,	· · · · · · · · · · · · · · · · · · ·
	T HV JK	Stream W	/idth*: 4	Section Widt	h (W): <u>' F+</u>
Observations:			OR-	<u> </u>	
	MERCHON PERMIT	Observational	Valority.	/ (9/)	Flow (Q)
//(m) (m)	(ft) (m) (cm)	Depth	At Poles		(m³is) (ft³is)
	- (0)	(ft)(m)	(ft/sk(m/s))	Average (ft/s)(m/s)	Q = (W)(D)(V)
			5) 0001 (00 () =) = = = 2 = = 1		-
3	0.3				<u> </u>
4	0.4	•	0,5		0.06
<u> </u>	0:34		40		_ 0.34
<i>(</i>	0,34		0,5		0.17
7	0.40	"	0		ð
8	0.28		1,0		0.28
9	0.6	· · · · · · · · · · · · · · · · · · ·	7.0		1,2
10	0.6	•	2.5		2.25
1(0.68		3,0		2.04
12	0.97		3,0		2.76
13	1.1		3,0		3,3
14	1.18		4.0		2.76 3,3 4.72
15	0140		4.0		lilp
16	0.80		3.5		2:8
17	1,2	,	1,0		1.5
18	11.42		3,0		4.26
19	0.8		1,5		1,2
20					
25					
*					-
			total		28.18



Stream: <u>Skor+</u>	+ Creek				Date: 28 March 2012
Station: <u>SC-1</u>		*****			
Description:				. <u>,</u>	
Time Begin: 12 1	Time En	d: <u>/2:24</u>	Meter Type:	. <u>.</u> .	11.0
Observers: TPT HV SR Stream Width*: 5.44			Section Width (W):		
Observations:					-
Section Midpoint			Velocit	y (V)	Flow (Q)
(ft)(m)	(f)(m) (cm)	Depth**	At Point	Average	(m³/s) (ft³/s)
100 (March 1997) 100 (March 1997) 101 (March 1997) 101 (March 1997) 101 (March 1997)	D	(ft)(m)	(ft/s.)(07/s)	(ft/s)(m/s)	Q = (W)(D)(V)
2.5	0.2		0.0		0
3.0	0.1		0.5		6.025
3.S	0.3		0.5		0,575
4.0	0.1	<u></u>	0.0		0
4.5	0.3		1.0		0.15
5.0	0,3		0.5		0.075
5.5	0.2		0.0		
6.0	0,5		1.5		0.375
6.5	0.2	<u> </u>	0.5		0.05
7.0	0.1		0.0		0
7.4	0.1		1.0		0
		-		!	
					
					ι, 2 <u>5</u>



Stream: <u>Kał (/</u> r-	cK				Date: 28 Marh 2012		
Station: <u> </u>							
Description:							
Time Begin:	Time End	d:	Meter Type:	,			
Observers: 197	HV 572	Stream W	'idth*: <u>6.64</u>	Section Widt	th (W): 6 mchar		
Observations:							
Section Midpoint	The state of the s	Observational	Velocit	y (V)	Flow (a)		
(ff))m)	(ff) (m) (cm)	Depth"	At Point	Average	(m³/a) (ft²/s)		
	(D)	(ft)(m)	(ft/s)(/fi//s)	(ft/s)(m/s)	Q = (W)(D)(V)		
1.5	0.4		0.5		0.1		
2.0	0,5		2.0		0,5		
7.5	0.65		1.5		0.4875		
3.0	0.7		1.5		0,525		
3.5	0.4		3.5		0.7		
4.0	0.3		3.0		0.45		
4.5	0.9		J. 0		0,45		
5.0	0.7		o.s		0.175		
5.5	0.4		1.0		0,04		
6.0	0.5		٥.5		0.125		
6.6	0.45		0.0		<u> </u>		
			,				
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Stream: 6	aly tobe			(Date: 25 MHZ/2
Description:	T = -		••		
Time Begin: (Di	3D Time End	: 10:36	Meter Type:	Sloka ()	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \
Observers:		•	idth*:\4 (Section Widt	h (W):
Observations:					
SESTEMBER MICHAELEN	Flow.(2)				
(7 (11) (m)	(fig in) tom)	Depth**	Velocit		(m³/s) (ft7s)
	(0)	(ft)(m)	At Point (ft/s)(m/s)	Average (ft/s)(m/s)	Q = (W)(D)(V)
3'	0.2		7		O
4	0.35		0,5	· · · · · · · · · · · · · · · · · · ·	0.175
5	\docume{\phi}, 75		0,5		0,375
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8	p.65		2,5		1.625
9	Ø.7Ø		1.5		1.05
10	\$75		1.5		1.125
	\$160		2.0		1.2
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CUSTOMER INFORMATION Shaded Areas • LAB INFORMATION: Writte Areas DATE RECEIVED LAB:

ADDRESS BILLING

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CLEW 120/ KINE / JOHN CONTACT ENVIRONMENTAL MONITORING, INCORPORATED ENVIRONMENTAL CONSULTANTS & ANALYTICAL LABORATORIES P.O. Box 1190 & Norion, Virginia 24273 & 276-679-6544

OR RETURNED TO CLIENT OR SAMPLES WILL BE DISPOSED EMI'S TERMS & CONDITIONS months D1525100 FOR FUTOR No Dissured Morms Charte OF IN ACCORDANCE WITH , REMARKS Report to be sent (if different then customer information): Anomaly Report Required: A-Holo METRY'S Archive for 2A Review PHONE (STATEZ 4 明明等 J S 414 7700 Salary Addition PABANETER (ANALYSIS REQUESTED) Sch Pa PRESERVATIVE USED NAME OF 1335 1 Temperalure of Cooler upon Receipt by Lab ei Li 1 While Area を Unknown Shac 153.5 100 PM "Ricelved By (sign.) OS H "Ricelved By (sugn) 15.25 古書の 200 **JOH** ٥ 1 Poison B омн Delettime Delemme . . 000) (000) SAMPLE 'NO. O. SAMPLING Requirements & Comments Slán Irritant Special Instructions / QC Relinquished by (eign) 'Relinquiched by (sign) COLLECTED 951 EPA COLLECTED Fiammable ESMAPL. 2 Day Shorking Days (Working Days) (Working Days) Additional Cost May Apply - Any TAT Not Specified Will Be Regular EMI PROJECT MANAGER CUSTOMER SAMPLE DENTIFICATION RYP *Required Information Non Hazard ۲۰۶ : emil-eled 28mar CLT H METHOD OF SHIPMENT TO LAB (circle) Hazard Information: (circle) COLLECTOR(S) SIGNATURE(S) EMI SAMPLE# FED. EX. Y TURIM-AROUND (circle): COLLECTED BY (putmt) EMI PROJECT NO.: Smello: Sc. CLIENT PROJ. NO. Patencidahed by (sing US MALE UPS 2 2

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ø õ Customer to complete all shaded categories, use additional forms if necessary

OTHER

PERSONAL DELIVERY

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Addilional Remarks:

STATE/ZIP



Log Sheet

SAMPLE LOGISHEET & CHAIN OF CUSTODY

LAB USE ONLY COC No.;

DATE RECEIVED LAB:

SAMPLES WILL BE DISPOSED CUSTOMER INFORMATION: Shaded Areas . [LAB INFORMATION: White Areas STATE/ZIP PHONE (FAX ADDRESS Ë PARAMETER (ANALYSIS REQUESTED) CLIENT CONTACT (Wooding Days) (Working Days) (Working Days) (Morking Days) ENVIRONMENTAL MONITORING, INCORPORATED ENVIRONMENTAL CONSULTANTS A ANALYTICAL LABORATORIES P.O. Box 1190 A Notion, Wighing 24273 A 276-675-6544 // 10 Day Additional Cost May Apply - Any TAT Not Specified Will Be Regular *Required Information TURN-AROUND (arcie): 2 Day COLLECTOR(S) SIGNATURE(S) *COLLECTED BY (print) SEP. CLIENT PROJ. NO. े आस्त्री

OR RETURNED TO CLIENT OR EMI'S TERMS & CONDITIONS OF IN ACCORDANCE WITH REMARKS Archive for 7 ESERVATIVE USED: 2919 'os'H الواجر омн C001 SAMPLING SAUPLE Requirements & Comments Special Instructions / QC COLLECTED COLLECTED E PA EMI PROJECT MANAGER CUSTOMER SAMPLE IDENTIFICATION RSP SFD EMI SAMPLE #

EMIPROJECT NO.:

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Received By (stgm)

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Additional Remarks;



LAB USE ONLY COC No.: CUSTOMER INFORMATION Shaded Areas . LAB INFORMATION: White Areas

DATE RECEIVED LAB;

CONTACT ENVIRONMENTAL MONITORING, INCORPORATED ENVIRONMENTAL CONSULTANTS & ANALYTICAL LABORATORIES P.O. Box 1190 A Notion, Virginia 24273 & 278-679-6544

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Ě PARAMETER (ANALYSIS REQUESTED)

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Customer to complete all shaded categories, use additional forms if necessary

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PERSONAL DELIVERY

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METHOD OF SHIPMENT TO LAB (chole) 🔆 🙉

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COC No.:

CUSTOMER INFORMATION: Shaded Areas . LAB INFORMATION: White Areas DATE RECEIVED LAB:

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ENVIRONMENTAL MONITORING, INCORPORATED

CLIENT ROLLING (No. CONTACT ENVIRONMENTAL CONSULTANTS ▲ ANALYTICAL LABORATORIES P.O. Box 1190 ▲ Norton, Virginia 24273 ▲ 276-679-6544

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Additional Remarks:

Customer to complete all shaded categories, use additional forms if necessary

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LAB USE ONLY COC No.;

DATE RECEIVED LAB:

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Customer to complete all shaded categories, use additional forms if necessary